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Comparison of CHEM Study CBA Laboratory Philosophies

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CHEM Study CBA

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The Chemical Bond Approach Project, CBA, and the Chemical Education Materials Study, CHEM Study, have some basic similarities and basic differences in their laboratory approaches. Both CHEM Study and CBA return to the original concept of the laboratory as a place to experiment. No sections are to be routinely filled out in the laboratory notebook. The students make their observations, record their data, and make their conclusions on blank pages of the laboratory notebook.

Both of these courses integrate the laboratory and the textbook. Rather than the laboratory being a supplement to the textbook, the laboratory is a unique and integrated part of the course where the student develops ideas and concepts by direct contact with the questions at hand in the laboratory. The laboratory turns out to be a place where there is "problem solving" rather than "problem doing".

With the emphasis on the laboratory it seems strange that neither of these two courses requires a vast quantity of costly equipment. The chemicals necessary for these new courses are generally found in a traditional chemistry stockroom. Balances are necessary in these courses, but the inexpensive trip balances costing $25 each are used by most high schools. Both CBA and CHEM Study have the philosophy that large technical devices exemplify technology, and not science and the processes of scientific thinking.

The time at which the laboratory is used in relationship to the rest of the course is the basic difference in CHEM Study and CBA. The CHEM Study idea is to send the student to the laboratory before he has read about the problem to be solved in the text or before he is faced with it to any extent in the classroom discussions. By asking thought provoking questions and by use of a rather detailed procedure, the student is first introduced to a concept in the laboratory. The CHEM Study idea is that the student will have to act as a scientist if he is going to solve the problem and it will also serve as a way to introduce a new topic, having built in student interest and understanding of the problem.

The CBA laboratory differs from the CHEM Study laboratory because it uses the laboratory after a topic, concept or model is discussed in class, and material has been read on it. The CBA idea is that by helping the student learn what a certain concept in chemistry is, and then allowing him to go to the laboratory to investigate or solve a problem the concept poses, the student will be placed on the frontier of science. They, therefore, emphasize problem solving rather than problem doing.

The CBA experiments are specifically designed to give help to a student in designing a problem and in helping him to solve it at the beginning of the year. Gradually as the student gets more acquainted with what he should do in the laboratory, less and less procedural help is given the student, until finally he can state his own problem and can devise a method to solve it. In this way the CBA course achieves one of its objectives in the use of "open" ended experiments."

One example of similarity in the two courses we can find at the beginning of both laboratory manuals. In the CBA course we find an experiment on determination of the contents of a "black box." The CBA idea is that the black box is not only symbolic of an attitude in science, but that chemicals are the chemist's black boxes.

The student studies the contents of the black box by shaking, twisting, listening, and other clever techniques. He tries to match the behavior of the box's contents with the model he has proposed for it. The one rule of the experiment is that the box can't be opened. At the end of the experiment the student is reminded that although this box could be opened to reveal the contents of the box, chemical models can't actually be opened, but can be opened only to the chemist's imaginative mind.

The CHEM Study experiment that is similar to the CBA black box experiment is called "Scientific Observation and Description." In this first experiment of the course, the student is asked to observe a burning candle. In this way the CHEM Study experiment introduces to the student the need for a neat and orderly description and the need for definite experimentation to check on what is happening chemically. By use of this burning candle most of the chemical systems used in the course can be introduced.

Another example of the CHEM Study and CBA experiments being similar, stems from the first writing of the two courses. Both projects working separately considered using the preparation of copper (I) sulfide as a demonstration of the Law of Definite Proportions. Generally this experiment gives results on the order of 1.8 or 1.9 to 1 as the ratio of parts copper used to sulfur, and not the value 2.0 to 1 as thought to be the answer. From running this preparation some of the great chemists working on writing these courses came up with these same values the students generally get. The writers of the courses knew that if they included this often used preparation they would confuse the error of theory with the error of experimentation, which was something they did not want to exemplify in an experiment such as this. The CHEM Study group ended up with a variation of the original preparations and added copper wire to a solution of silver nitrate to show the Law of Definite Proportions. The CBA writers ended up with an experiment based on the addition of silver nitrate to sodium chloride. Both of these experiments give accurate results and therefore back up the theory to be worked on. In this way they were able to limit confusion that may have come up.

It can be seen that there are some likenesses and differences in the philosophies and in the actual laboratory work in both courses. By observing a CBA chemistry class at University High School at Iowa City, Iowa, and by teaching CHEM Study at Washington High School in Cedar Rapids, Iowa, the writer found the following things to be in common in the two courses: 1.) the laboratory is integrated as a part of the whole chemistry course, 2.) the laboratory programs help exemplify the role of a scientist, 3.) minimum cost is emphasized, 4.) emphasis in the laboratory is placed on understanding science and not some technical device, 5.) open end questions are asked rather than fill in the blank type questions, and 6.) the laboratory is a place of problem solving and not problem doing.

In the CBA course it can be seen that more work is required by the student and especially by the chemistry instructor in pre-laboratory discussion, than in the CHEM Study course. Because the students at University High School had a good background, they were planning to go to college, and the instructor was very motivating and put quite a bit of work in on the course, the CBA laboratories were operating very close to the goals of the CBA philosophy.

In CHEM Study the problem comes up as to when to run which experiment as an introduction. If an experiment were run several days out of proper sequence, it can be seen that the laboratory work would be a duplication of what had been discussed more rigorously in class discussion or in the textbook. The CHEM Study planners have relieved a great amount of work from the individual teachers hands by publishing a CHEM Study Teacher's Manual. This teacher's manual outlines the times when an experiment should be used in relation to the rest of the course. This solves most of the problems of the CHEM Study teacher.

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to know a fly . . .

Dethier, Vincent G. (1962). *To Know a Fly, San Francisco: Holden-Day Inc. viii plus* 119 *pages. Illustrated. Price:* $3.75.

Here is a rare presentation of a research biologist in action, matching wits with (of all things) a fly. While most people think of the research man as being cold and calculating and the fly as a filthy insect, a different story is told here. This book leads one to believe that both the fly and the researcher are almost human.

Dethier makes delightful reading of some usually-dull research work on the fly. The problems encountered in working with this little beast are numerous, but the solutions to these problems become as exciting as the best mystery story and as comical as the three stooges. How do you make a fly fly? How does a fly taste? How much can a fly drink? What can you teach a fly? These are some of the questions answered in a manner that can be easily read by the most innocent layman and still appreciated by the most diligent research worker.

My lone criticism of the book is that it is too short. When I am enjoying something so thoroughly, I dislike seeing it end so quickly.

--Raymond L. Sloan, State College of Iowa.

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